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AUTHOR Quinlan, Kathleen M.
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ABSTRACT

This study examined disciplinary differences in college teaching using data from a national study of peer review of teaching to look at values about teaching held by faculty in the contrasting disciplines of history and chemistry. Data for this study were from written exercises completed by faculty participants (14 historians and 12 chemists) and observations of discussions of discipline-specific groups of faculty. The analysis focused on each discipline's view of intellectual standards, mission, perception of students and their roles, and perceptions of the learning process. Comparison of the two disciplines suggested that, in both disciplines, professors were concerned with overcoming their field's bad stereotypes and the need to promote overall critical thoughtfulness about, engagement with, and ability to understand and apply the themes or principles of the discipline's body of knowledge. Both groups also showed concern for developing students' study habits. Historians, however, were committed to the liberal education of all students while chemists spoke only about teaching scientific skills and knowledge to science majors. Historians saw the students as unique individual learners whereas chemists did not address students' unique individual needs, goals, and interests but spoke of the students as a monolithic body competing among themselves along the same predetermined course. (Contains 35 references.) Better understandings of the core similarities and differences between fields may be critical of the success of integrated interdisciplinary scholarly endeavors. (JB)

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# Uncovering Discipline-Specific Interpretations of the "Scholarship of Teaching:" Peer Review and Faculty Perceptions of Scholarly Teaching

**Kathleen M. Quinlan**
Stanford University School of Education

Paper prepared for the annual meeting of the Association for the Study of Higher Education, Tucson, AZ, November 10-13, 1994

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Texas A&M University
Department of Educational
Administration
College Station, TX 77843
(409) 845-0393

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**Uncovering Discipline-Specific Interpretations of the "Scholarship of Teaching:" Peer Review and Faculty Perceptions of Scholarly Teaching**

**Abstract**

*Through his concept of the scholarship of teaching, Boyer has generated considerable interest in the discipline-specific peer review of teaching in higher education. However little is known about those disciplinary differences in teaching which lie at the heart of "scholarship." Addressing this gap, this paper reports on a study of values about teaching held by faculty in contrasting disciplines-history and chemistry. By analyzing written documentation of teaching and observations of group discussions based on those written materials, the following question is explored: As faculty in different disciplines talk about their teaching practice, what differences and similarities emerge? Findings and implications are discussed.*

**Introduction**

The quality of teaching in higher education, particularly in research and comprehensive universities, has been the subject of much concern in recent years (Bok, 1992; Boyer, 1990; Langenberg, 1992; Marchese, 1990; Shelton & DeZure, 1993; Wagener, 1991; Zemsky, 1992). Efforts are being launched by campuses and professional societies(Diamond, 1993; Edgerton, 1992, September) to find ways in which teaching can be better recognized and supported within a system of formal and informal rewards which have tended to favor research accomplishments.

A key strategy in this attempt to improve the status of teaching in higher education, has been to view instructional activities as examples of or analogous to scholarly research, which is highly valued within academia. Through Ernest Boyer's reconceptualization of faculty work, *Scholarship Reconsidered*, the notion of the "scholarship of teaching" has attracted much attention among administrators, policy makers and higher education researchers(Boyer, 1990). Lee Shulman (Shulman, 1993) has articulated some of the key aspects of that scholarship metaphor by referring to the need to make teaching "community property." He proposes that, "in our life as scholars, we are members of active communities: communities of conversations, communities of evaluation, communities in which we gather with others in our invisible colleges to exchange our findings, our methods, and our excuses." He argues that in order for teaching to share a privileged status, it must be connected to the disciplines which define scholars' communities, documented richly and publicly before that community of peers, and subjected to the same sort of scholarly critique and evaluation accorded to research (Shulman, 1993 p. 6-7) .This thinking has formed the rationale to support

a rash of recent campus policies mandating that teaching be peer reviewed (American Association for Higher Education, 1994).

Yet, we know little about what actually constitutes the "scholarship" of teaching and how those scholarly aspects can best be documented or judged. Much of the research on (and practice of) college and university teaching improvement and evaluation has focused on overarching, non-discipline-specific teaching techniques(Dunkin & Barnes, 1986). The emphasis on student ratings of instruction has meant that effective teaching has been defined in terms of presentational style, focusing on such factors as enthusiasm and organization and clarity (Feldman, 1976 and Seldin, 1980 in Donald, 1985) Because these analyses of effective teaching have derived from students' perspective and students in a field are poorly positioned to judge their instructors' knowledge of the subject matter (Miller, 1987), this very important dimension of good teaching has been shortchanged in the literature on teaching in higher education (Donald, 1985). Yet a faculty member's understanding of and representations of their subject matter is precisely the dimension which lies closest to the heart of scholarship.

Through a series of psychological studies, Janet Donald (Donald, 1986; Donald, 1990; Donald, 1992)has demonstrated interesting differences between the knowledge structures of different disciplines which provide a starting point for my data collection and analyses. She found, in a study of professors' views of knowledge validation procedures, that faculty in the natural and social sciences were more likely to rely on the use of empirical evidence and reproducibility than professors in the humanities who put more credence in judgments by peers of the credibility, acceptability and plausibility of their scholarship. Professors in pure fields (physics, psychology, English literature) were more likely to turn to conflicting evidence, counterexamples or alternative explanations to validate their conclusions than their counterparts in matched applied fields (engineering, education, English language)(Donald, 1990) . By analyzing the content of courses from different disciplines, she found variability in knowledge acquisition at three other levels in addition to differences in the validation processes used in each discipline (Donald, 1986). Disciplinary differences in the nature of the concepts presented in the courses, the logical structure and relationships among concepts, and differences in preferred thinking processes or inquiry methods were also found.

These findings suggest that faculty in different disciplines will value different phases of their teaching or different forms of evidence as indicative of

scholarly prowess. The ways in which different groups of faculty are used to thinking about the world will influence the ways in which they view teaching and learning. In addition, the nature of the knowledge that those groups have constructed within a particular field will also affect the substance of the teaching, and therefore, the ways in which teachers teach in particular fields. Since the work patterns, world views and processes for thinking, knowledge acquisition and validation differ among the disciplines (Becher, 1981; Becher, 1984; Donald, 1986; Donald, 1990; Donald, 1992), the scholarship of teaching, then, must also necessarily be defined differently in different disciplines.

Thus, an important empirical question to guide initial steps in the implementation of programs of peer evaluation of teaching is simply, "What do the evaluators (the faculty in particular disciplines)*value* ?" In other words, as faculty write and talk about their teaching, what aspects of teaching do they value most? What disciplinary differences emerge in these valued (scholarly) aspects of teaching and in the types of evidence which are preferred for supporting judgments about scholarly dimensions of teaching?

In summary, these research questions are based on three related assumptions: 1) Some aspects of teaching can be considered scholarship; and the evaluation and improvement of those aspects can be treated analogously to research. 2) Those scholarly aspects are directly connected to the discipline represented by the scholar-teacher. 3) Those scholar-teachers are in the best position to define the scholarly aspects of teaching in their field.

**Method**

This study takes place within the context of a national peer review project coordinated by the American Association for Higher Education's Teaching Initiative. Thirty six departments in twelve universities (6 research, 6 comprehensive), representing at least two disciplines in each of the following clusters: humanities, sciences, professional (applied) fields are involved in the project. Two faculty members (tenured in almost all cases) in each department were asked to complete exercises on the peer review of teaching by choosing an artifact of their own teaching (such as a syllabus, a videotape of classroom teaching, or examples of student work),writing a self-reflective statement which comments on the work sample and exchanging the exercise with a colleague. Separate exercises were designed to draw out analysis of three different but interconnected teaching tasks: 1) course design and preparation for teaching, 2) classroom interactions and events, and 3) assessing learning outcomes through evaluation of student

work. (Edgerton, Hutchings, & Quinlan, 1991) Although all participants received the same set of instructions and prompts to guide their work on each of the exercises, the guiding questions and suggestions granted the scholar-teachers a considerable amount of flexibility and freedom in what teaching artifacts they selected and how they focused their commentaries.

After spending two to three months preparing these exercises, all participants then attended a workshop in which they shared their entries and responses to the exercises with their peers at other participating universities during semi-structured discussions.

I drew on two main sources of data in this study: 1) the content of the written exercises (the artifact and the commentaries) completed by faculty participants and 2) observations of discussions of discipline-specific groups of faculty participants centered around the exercises. In order to maximize the disciplinary differences observed, I compared and contrasted the materials and responses of faculty in a humanities discipline (history) to those of a science discipline (chemistry). Fourteen historians, representing eight different universities, participated in the Institute discussions. Eight of these faculty contributed partial or full sets of written exercises for analysis in this study. Twelve chemists, representing six universities, participated. Eight chemists also contributed some or all of the written exercises. For three of the universities, both the chemistry and history departments were represented.

**Findings: History**

Intellectual Standards: Doing History

Since the project was intended to promote discipline-specific considerations of teaching standards, the faculty frequently focused on the importance of giving student a sense of what it is like to "do history," through the courses that they offer. The group saw history as resting on the reading, interpretation, critique and writing of arguments. One member expressed admiration of a colleague's work for his dedication to, "trying to get students to see that history is about real people effected by real events. He gave them information and let them create interpretations." Many expressed in some way the need for students to manipulate ideas or larger themes, not just facts.

In discussing standards and processes by which courses could be evaluated, this group of historians were able to easily think of their courses as scholarly arguments which could be evaluated in similar ways as one would review a colleague's other scholarly research. One professor, for example, compared the

process of evaluating a colleague's course to evaluating a history book by, "looking at the underlying assumptions [of the course], the conceptualization of [my colleague's] course, asking "what does it contribute to students' (reader's) knowledge of the subject..." Another historian framed this set of criteria in more explicit teaching terms, by suggesting standards which consider, "whether the course is well thought out, are the readings significant and whether the questions/expectations are appropriate for college/university students. "

Mission: Caretakers of Liberal Education

While the historians in this group agreed that students should experience historical thinking through their coursework, they believe in the value of their disciplinary modes of thinking for all students, majors as well as nonmajors. One senior professor began the commentary on his course by citing a recent statement issued by his department. The excerpt from the statement condemns what members see as a trend toward, "specialization and professionalization in the university curriculum," and "narrow preparations of undergraduates," calling it "parochial and thought-constraining." As a department they state that, "we reaffirm our commitment to the value of the study of history of civilization as a means of enhancing the broad goals of a liberal education."

Similarly, another historian from a different university writes that one of the two major objectives for his course is one which is fit for all college students,

> "one that is not necessarily defined by my discipline. Rather it reflects, I believe, what the objective of any liberal arts course should be: to improve the students' critical reading, writing and thinking skills, to develop through carefully crafted assignments the students' ability to conceptualize, organize and analyze a complex body of material, and to stimulate a life long love for learning."

This commitment to providing a liberal education for all of the universities' students also shapes the major challenge that many of these teacher-scholars face. A faculty member from yet another university describes the central dilemma of his teaching as trying to meet the needs of a variety of students, with a "range of backgrounds and abilities." He writes about his course, "The Development of the Modern American City",

> "Because I value the participation of all these kinds of students...I have resisted the temptation to make my life easier by targeting a particular audience...As a result, the goals of the course as I teach it reflect its hybrid characteristics. They are: (1) to bolster each student's knowledge of U.S. social and economic history ...(2) to help students understand the past of today's present...(3) to help stu-

> dents understand the "otherness" of the past. ..(4) to encourage students to think of cities and their institutions as texts for historical interpretation...(5) to encourage students to think critically about what a city IS...My varied students are not equally positioned to attain all of these goals. Some of my beloved engineers struggle to get much beyond goal (2). The brightest of the history majors want to spend all their time on goals (4) and (5). My challenge, which I have met with mixed success over the 20 years I have been teaching this course, is to devise instructional materials and evaluation mechanisms that are fair to all concerned. My general strategy is to provide numerous ways for student to make their intellectual entry to the course materials, multiple means of evaluations, and lots of chances for feedback."

From the other written exercises and the discussions, I found that many of the history faculty were struggling with the challenge that a heterogeneous class posed. In a written review of a colleagues' course, another professor also noted the equity issues which arise when students with various academic backgrounds are invited into the same course:

> "In order not to discourage students from taking a course that we feel would be a wonderful learning experience for them, we often do not require prerequisites. But do we put students who have not taken the basic U.S. history courses, etc. at a disadvantage with those students who have? Is it really fair to advertise a course in that way -even for the best of intentions-if a knowledge of the period in which someone lived would be very valuable in both the discussions and the exams for the course?"

While some found it stimulating to push their teaching skills to the limit by designing multiple assignments and assessments, and others questioned the ethics of decisions about prerequisites, yet others preferred to define a narrower student audience for their courses. One professor acknowledged that his lower division course should:

> "provide a solid foundation for students wishing to continue in... [this field]. It should also provide a good background for students in English and Comparative Literature. Not that all those who enroll in it will be history or English majors, or that they will take more history courses. For some, it will be the only History course they will ever take. This means that, as in all of our survey courses, there will be a very wide variety of students in terms of their prior knowledge and skills, as well as in terms of their interests and purposes for being there."

But his response to this variety in students' prior competency was, "I wish that our department paid more attention to controlling enrollments, so that we

instructors could know our audiences better. Maybe I will look into that when I teach [this course] again."

The recognition of the need to tailor goals to different students led to debates about legitimate course goals for majors vs. nonmajors. The group agreed quickly on the importance of learning to distinguishing between primary and secondary sources, working with primary sources, and learning to recognize and write historical arguments. But when and where these skills should come within the curriculum was harder to resolve. One participant pointed out that the manipulation of primary source documents is often something which is required only of senior level majors, yet the conversation suggested that familiarity with primary sources should be introduced to all students of history, majors and nonmajors alike. They wondered if it might be possible to sequence courses so that the easier skill of recognizing and criticizing historical arguments would precede courses which involve writing historical theses. Here again, though, is the dilemma of whether to assign prerequisites for some courses, an action which would exclude many students who may be able to learn a lot from the course. The written exercises, as well as the thoughtful debate among the group indicated that many were reluctant to give up what one referred to as his, "beloved engineers."

This dilemma arises perhaps most pointedly in courses in regional or area studies. Such courses often draw students with considerable history background but with little or no knowledge of that region or area while also drawing students with extensive backgrounds in that area but with little or no prior experience with the methods or habits of mind of historians. In such cases, where courses may even be cross-listed with other programs or majors, setting appropriate goals for student learning becomes even more complicated.

The group seemed most comfortable with the conclusion that with the wide number of excellent choices about goals and content of courses, it may be difficult to reach any consensus about a single set of goals which should be applied across any given set of courses. Throughout the discussions these historians honored individuals' differing choices, whether those be the decisions and agendas of teachers or of students. Their concern for the wide variety of student needs they are serving, suggested a faculty which is sensitive to a commitment to liberal education, not just the education of future specialists in their fields.

Perceptions of Students and their Roles

The historians' appreciation for the variety of individuals they educate in their classes also manifested itself in their conversation about assessing student learning. Early in the discussion, the group seemed uncomfortable with the idea of using standardized assessments of student learning as a measure of faculty teaching performance. Two of the faculty expressed dismay with the examples of classroom assessment techniques which were featured in a presentation made just prior to the break-out discussion. They both feared that those whole-class techniques focused too much on "quantification," and seemed to assess "only the median." Two others verbalized a desire for assessments of *individual* learners, preferring to consider individual cases, mentoring, and examples of how faculty "intervene in students lives in ways that are not necessarily subject specific." Underlying these comments seems to be a perception of each individual student (and therefore each individual interaction with them) as unique, multidimensional and valuable.

The group also acknowledged, consistent with the comments quoted above, that not only do instructors have goals for students, but that students come with "vastly different agendas "and are there to "learn different things." By acknowledging the uniqueness of their students, they touched on the question of whether student learning should be assessed against the instructor's goals, against the student's own goals for the course or against the students individual progress and development over the course. One early career (mid career-not sure?) member of the group went so far as to question the practice of announcing the goals and objectives for a course in the syllabus and on the first day of class. Instead, she now is beginning to think that that practice makes a course seem too rigid, whereas she would like the course to evolve and unfold with the students goals, interests and contributions.

The multidimensionality of their students was seen by at least two other scholar-teachers as critical to the success of the course. " I focus on student characteristics because I regard a mix of traditional and non-traditional, male and female, and differing ages, ethnic, racial and class backgrounds an important element in the success of this course."

Several other faculty members also noted the importance of the diversity of their students; one in the context of future career plans, another in the context of differing races and origins in different parts of the country or world, another including the significance of a mix of differing aged students. The various expe-

riences and perspectives which different students brought to and shared with the class were seen as important contributions to the curriculum and process of the courses.

Perceptions of the Learning Process

Seven of the faculty wrote in some way about the learning process as a process of personally and emotionally engaging students with the material of their courses. Many of these historians draw on biographies and autobiographies to help students to experience the lifeblood of history . One professor wrote, "I believe that biography is an important approach to the study of history, because it brings flesh and life to an otherwise series of treaties and wars." In a review of a colleague's work who relies heavily on autobiography, he elaborated on the way in which this personal aspect helps engage his students:

> "I really believe students will remember Washington, Jefferson, Confucius, Jyang Kai-shek, Ho Chi-minh more fully and longer, if...students have fleshed them out with autobiographical and biographical details. To see Mao sitting around in his underwear and picking out cooties from his body, or Jefferson puttering around in a workshop on one more invention or labor saving device for his home, etc. really does bring life to the individuals we are discussing with our students."

While that quote reflects the importance of personalizing and humanizing history as a means of promoting retention of information, another scholar/teacher at a different university described the significance of his course in different terms. He writes about his course as a mirror which allows students to examine their own lives and rethink the worlds in which they live.

> "[the course serves as]...a means of clarifying [students'] own values through analyzing events in the past. The argument here is that history is not primarily, a study of events of the past for their own sake, but a method of inquiry, thought, and evaluation which is of use in understanding the present in general and of one's own life in particular...I also encourage the students to see the connection of great civilizations of the world to the diversity of students around them on campus and in [this city]...I also try to get them to see how idiosyncratic and strange is the world they have experienced up till now. I try to get them to see that [this university], and [this city], and the U.S.A. are, in world perspective, quite unusual places and institutions. To some degree I try to get them to step outside themselves and see events from other perspectives."

This desire to have students connect the history they are learning with their own lives situated in the present day U.S. was echoed by a number of oth-

ers. Some acknowledge freely that emotion plays strongly in this view of learning as a transformative process:

> "I also take much satisfaction in the revelatory nature of much of this material to students. Even those who think they have a good understanding of the region, its racial heritage, etc., often express dismay and discomfort in reading these intimate accounts...[which] leave students with a far more sophisticated sense of the complexity and diversity of [the history of this region]., and the importance of the human variables always at play in shaping it."

These comments illustrate the importance these historians place on conveying the vitality of their fields to their students by engaging students personally in the material they are studying. This view rests firmly in an appreciation for the humanness of their students, as well a view of learning as a process of individual change which is fostered through dialectical processes which allow students to 'try on' different points of view.

Styles of Teaching and the Status Quo

While much of the discussion and written work focused on high-level intellectual standards linked to content, assignments and objectives for students, the prompt to "identify the standards that might be applied to the review of teaching as a scholarly activity" also evoked some confusion as the historians thought about the current realities in their departments. They commented that in their own departments acceptable teaching was defined as whether the "students dropped in droves (or not)" or how well faculty scored on a "general overall effectiveness" question on a student evaluation form. Such current standards typify what Lee Shulman calls Board of Health standards, which simply certify that it's safe to dine there, rather than the more lofty standards of, say, the Michelin Guide, which recommends only excellent fare and service.

Some of the other issues which came up in considerations of current standards in their departments illustrated a tension between their valuing of active student involvement and their own experience and expertise in lecturing. One professor noted that debates about good teaching in his department center on debates about lecture vs. student-centered approaches. Another professor from a different university explained his choice of a class episode to write about,

> "I have chosen this class because...it is an example of combining lecture with discussion in a structured way - a technique that I value but do not often employ successfully...I think it is successful and... I do not know how to do it more often."

Some noted the tradeoff between student discussion and "coverage" of material. Yet another wrote candidly,

> "that I always struggle to get a proper balance in my seminars between pursuing my goals and objectives that I bring into class and allowing for the development of those spontaneous moments where the discussion is more free form and takes on its own dynamic.".

One member of the group described with some concern what he sees as a "tacit agreement" in his department that "good teaching" means that teachers "make good eye contact, involve many students and are student-centered," adding that lecture styles are frowned upon.

Most of the participants were very hesitant to prescribe particular approaches or styles as being better than others and did not want standards to dictate this. There was general agreement that each teacher does their best when they develop their own classroom style which fits with their own personality.

A Reconciliation: Intellectual Standards without Standardization However, the group found a reconciliation which seemed to satisfy them, which one participant phrased as, "Tying together the objectives with the delivery system." By assessing an instructor on the "consistency between their mission and their methods," faculty would be judging their peers against the reveiwees own stated goals to determine how effectively he or she carried out those goals. Thus the question which would guide their review would be, as another put it, "Does he [the instructor] accomplish what he wants to do? How well?" Such an approach would allow faculty to assess their peers work while also honoring individual's choices, values and teaching styles.

**Findings: Chemistry**

Intellectual Standards: Doing Science

Like the historians, the chemists believed that it is important for their students to "think like scientists." Almost all of the participants emphasized problem-solving, especially multi-step problem-solving, as a main objective of their courses.

> "My overall philosophy in teaching this course is to consider it one in problem solving. Most of the engineers will forget the chemistry presented; many of the biologists will also, although they will ultimately be exposed to considerable chemistry. But every student in engineering and the physical sciences will survive by the ability to think critically, reason abstractly, and solve problems."

Another scholar/teacher wrote about his use of historical and personal information about prominent scientists to contextualize the developments in a given field. In his written piece he focuses on having students understand what models and laws are, their differences and their significance in science:

> "The object of this historical discussion is to emphasize that scientific models and just that -- models. They are to be used and not necessarily believed. This is very disturbing to many students who want to think of science as an academic field wihich is embedded in irrefutable facts. To emphasize this concept, I point out that some of the greatest thinkers in the world have been completely wrong in their ideas about science....General Chemistry lays the basic foundation for further studies in chemistry including organic chemistry. There are many topics that students must understand from general chemistry before proceeding to organic chemistry. These topics are reaction kinetics, thermodynamics, all aspects of chemical bonding, and acid-base concepts among many others. I emphasize that just because reactions involve organic compounds rather than inorganic compounds the basic laws of chemical reactivity do not change."

Another faculty member described a nontraditional approach to teaching a freshman level course in analytical chemistry in which he relies heavily on the use of team projects to complete open-ended analyses. He expresses his satisfaction with the results of his approach as:

> "Students learn many things from these projects but one of the most important is the realization that no experiment should be a failure and that few things work perfectly the first time. Every experiment is a "good" experiment if the investigators can learn from it so they can make a better approximation in the future. Students in the course feel like they have gained deeper insights into what it feels like to be a scientist. The oral discussions of group projects reveal that students have acquired sophisticated insights into the course material. These discussions usually focus on issues of research strategy and not on remedial issues. They report that the thinking skills and approaches they have learned from the course have been helpful in following science courses. The approach appears to have increased the depth and breadth of understanding in the course as well as improving the higher level thinking skills over approaches using the more traditional techniques."

Other skills that were mentioned as important for chemists and students of chemistry were the abilities to translate between English and mathematical notation, to draw chemical structures, and to communicate results effectively. From the comments of a number of these scholar/teachers, "thinking like a scientist," though, also seems to means "feeling like a scientist." Members of the

group spoke of needing to model and instill the "excitement of discovery," and also to develop in students an appreciation for the "beauty" of the interconnections between concepts, experiments and general models. Furthermore, as the last quote suggested, involving students in realistic, projects that do not have a defined outcome, means that student experiments often fail. But, that professor argues for the value of experiencing the frustration of failed experiments,

> "it appears that the learning opportunities are enhanced by this approach because of the struggle that students go through as they think about the problems and the exposure to how a scientist feels when things don't work. For the students that struggle through the problems and reach the point where they can get the experiment to actually work, there is an additional feeling of satisfaction that comes with realizing the results of hard work."

While the historians wanted students to develop the habits of mind of historians, these chemists also want their students to develop the habits of mind and emotion of scientists.

Preparing Future Scientists

While the historians saw themselves as liberal educators whose job it was to teach both majors and nonmajors, the chemists spoke and wrote exclusively about science majors, and in particular chemistry majors. Because subject matter in chemistry is hierarchically structured and sequenced, in contrast to history courses which are not, few non science majors would be enrolling in upper level courses in chemistry so it is not surprising that chemistry faculty do not think very much about nonscience majors. But it is notable that many of the faculty were writing about and discussing introductory courses and lower division courses, and still there were no references to non-science majors. Thus it seems that their descriptions of the importance of "thinking like a scientist" are considered important only for those students who will literally become scientists, while the historians seem to believe that learning to "think like a historian" is important for all undergraduates. These contrasting views of their mission are closely linked with what each disciplinary group saw as their major challenges.

Student Learning and Student Evaluation

In their writing and discussion of the exercise on student learning, the chemists spent a great deal of time discussing how to *evaluate* their students' learning. Each member of the group described their assignments or exams and student achievement on those tests, and other members of the group asked questions about the type and number of students in the class and the range of student

scores. Discussion of the grading of student work revealed a strong shared assumption among most of the scientists that students' abilities fall on a single bell curve. One professor wrote,

> "The final examination presents to the student an opportunity to demonstrate some mastery of critical thinking and abstract reasoning as applied to chemistry. The questions are neither easier nor harder than many assigned in the text and in the supplementary handouts...In keeping with the philosophy that the course centers around problem solving, the final examination consists of eight numerical problems. There are no short questions and no multiple-choice questions. The final was hand-graded, with generous credit being given for delineating key points of logic and knowledge, even in the face of numerical errors...Recall that the final was worth 400 out of 900 total points possible in the course. Some students finished the two-hour final early; most stayed until the end. I did not get the impression that the students were overly pressed for time. In many instances it was not time that was a factor, but their ability to see where the problem was going. The actual working of the problems did not require excessive detail. This final averaged 262 out of 400 points. I consider an average of 65% to be ideal. Scores for the 469 students in the course ranged from 395 to 45! (Incidentally, total scores in the course ranged from 866 to 277 out of a possible 900, with the average being 606.) With a 65% average I am satisfied that the average student learned considerable chemistry and at the same time improved his or her problem-solving skills. This class performed about as well as the usual."

Another professor, teaching a small honors class, echoed this attitude, saying that his final exam had a class average of 70% and that he was "happy with that" and that it "met my expectations." Yet others justified assignments which deviated from the traditional in-class finals by pointing out that the distribution of student scores with their approach correlated with score distributions on in-class finals. Experiments which diverged from the in-class final included the use of open-ended and group projects and presentations, designing customized-individualized take home exams which they can work on together, or providing the opportunity to correct exam questions later at home for half-credit. Even across this range of different examination methods, achieving a wide variance in student scores is apparently important and a sign of rigor. One professor concluded that instructors should "just give them a good, tough final exam - that's the best evidence [of whether they are learning what we want them to]."

The emphasis on the 65-70% average score within a Gaussian distribution means necessarily that many students will fail the class and be excluded from

moving to the next course in the sequence. Grading "on a curve," therefore, serves as an efficient sorting device to ensure that only the top of the top of the students will make it through a chemistry major and on to graduate school. This was generally accepted despite a couple of these scholar-teachers protesting against an attitude of "weeding out" saying "it is easy to flunk students, but that attitude [of weeding out] is the problem - our obligation is to educate, not to flunk." (**)

In addition to those protesters, two other scholars-teachers, representing the same institution, questioned the validity of the standard evaluation practices, though. One pointed out that some of his best graduate students were not those with the best GPA's or GRE scores. He had seen some his C students turn out to be terrific researchers. From this evidence, he concludes that there is "something else which is important which our exams are missing to predict skill at research."(**) He has become committed to having students work in small groups doing advanced open-ended projects which "require all different kinds of skills to come into play in the cooperation." (**) That team of two, more than the other members of the group from other departments, talked about the variety of skills which they need to assess and not simply a single set which are more easily measured by traditional, individualized and competitive exams and problem sets.

The biggest challenge they seemed to face, given the emphases in their discussion, was how to accurately measure and sort students on their potential to be successful scientists.

Perceptions of Students and their Roles

There was more discussion among the chemists about the problem of motivating students than there had been among the historians. Some of the instructors attributed low scores on exams to student unwillingness to "work hard." In describing his score distribution on a final exam, one chemist pointed out with a frustration that there is a "good correlation between doing the problem sets and attending problem sessions and doing well on the exam, as usual." Some of his colleagues, at another point in a discussion, seemed frustrated that they couldn't "get students to believe you - to trust you" that they needed to spend a lot of time on studying.

All of the chemistry syllabi contained some study tips. One scholar-teacher wrote the following on the first page of his syllabus:

> "In working problems, wherever possible get a complete set-up before you do any arithmetic. First, give a set-up in symbols and in

> numbers. Suppose you had the problem, what is the change in pressure when 1.750 moles of hydrogen is changed from 25.00 degrees C, 40,000 cc to 100 degrees C, 22,000 cc. Do it this way...[he shows an example of setting up the problem]...Now do the arithmetic. This procedure fits a pocket calculator. If there is to be cancellation, you will see it. It is much easier to locate errors. Where problems appear on examinations, the setup is your way of proving that you understood the approach even when you did not produce the correct numerical result. This leads to large partial credit. PLEASE TAKE THIS SERIOUSLY. "

In the discussion and in the study tips, it seemed that it wasn't just a matter of spending more time on task, but rather that the quality of the learning time was important. Students were advised, as above, to set up problems before beginning computation, to "study the principles before you try the problems," and to "copy the [lecture notes on reserve in the library] and bring them to class, listen attentively and add supplemental material to them." Another professor attached a short article on study habits to his syllabus.

The faculty generally agreed that students need to be actively engaged and thinking about what they are doing. "How do we teach students to observe, to reason, to use common sense to be reasonable?" But, there were two different interpretations within the group about the implications and possible solutions to the problem of motivating students to become engaged learners. One group encouraged faculty to ask students to work cooperatively to solve open-ended, real world problems which draw on scientific inquiry and analytical skills. Students "get fired up about it," said one and another argued that, "open ended questions or projects can really stimulate creativity and effort on the part of students that you would never have dreamed of." Skeptics, though, displayed a distrust of students' commitment to their studies, pointing to problems with poor attendance, cheating, and incomplete homework sets. One professor stated that students simply "aren't willing to work hard enough," to be successful in chemistry. The testimony offered from the "real world problems" group showed a respect for the good work that students do in their classes and suggested that it was the responsibility of instructors to provide assignments and support which serve to excite and challenge students to do their best work. The "lecture, homework and test" group, on the other hand, seemed to place responsibility and blame for students' lack of thoughtfulness on the students themselves. For example, the "lecture, homework, and test" group asked their "real world problems" colleagues whether they were teaching a select group of above average students.

Cheating was also a concern among several of the chemistry faculty. Half of the syllabi gave warnings about the severity of punishments for cheating. The chemists spent some of their discussion time on cheating issues, during which several suggestions were offered about preventing or defining cheating. This attention to student integrity stands in striking contrast to their colleagues in history. Only one out of the eight history syllabi made threats about the consequences of cheating and the issue was not addressed in the discussions I observed. Given the value placed on the rigorous and competitive evaluation of students among these chemists, it is logical that they should also focus their attention on students who try to earn unfair advantages in the careful grading systems they have constructed. It is also possible, given such a competitive grading environment, that there actually are more instances of cheating occurring in the chemistry courses than in the history courses.

Standards for the Evaluation of Teaching

Just as this group of scientists was concerned with the construction of accurate, fair standardized measurements of student achievement, they also focused a significant part of their discussion about standards for the evaluation of teaching on measurement issues. They wondered out loud how they could measure and document the aspects of teaching that they cared about, such as offering students opportunities to experience the "excitement of discovery" or to "think differently about chemistry." As one might expect given their quantitative, experimental training, they also wanted outcomes-based data on the effectiveness of various teaching techniques.

When discussing the particular exercises that they had completed, they agreed almost unanimously that syllabi are not useful tools for evaluating teaching. Because so much of the curriculum is mandated by the American Chemical Society and/or by their departments, they do not typically view their course outlines as examples of or indicators of their scholarly work. The group did talk favorably, though, about the opportunity to write reflections about their teaching which they did in conjunction with each of the exercises. One commented that the type of reflection that he did in writing the accompanying memos for the exercises was his first opportunity to think carefully about what he does and why. Others echoed his comments on the usefulness of reflecting on their course goals and philosophies, pointing out that it might be helpful for students to see such statements as well. Several of these scientists also indicated that seeing the assignments and exams that their peers prepared gives them the best picture of

what their colleagues expect from their students. Through those assignments they believe that they can judge the kinds of skills their colleagues want students to develop.

**Discussion**

Similarities

Examining the perspectives that these two different disciplines bring to discussions about the meaning and evaluation of the scholarship of teaching reveals some common struggles and rewards, but also striking differences between faculty who share the same campuses and the same students.

In both disciplines, professors were concerned with overcoming the bad stereotypes of their field which students may have picked up in their earlier schooling. In history, the faculty perceived themselves as needing to overcome student perceptions of history as a boring series of events and facts. The chemistry faculty spoke of going beyond "cookbook" experiments and memorization of rules, without an understanding of how to apply them. These faculty, then, seem to agree on the need to promote an overall critical thoughtfulness about, engagement with and ability to understand and apply the themes or principles of the material they are studying. In this regard, these university faculty are aiming for the same educational goals that primary and secondary school reformers are currently advocating (for example Sizer, 1992)

Relatedly, there was strong evidence among the chemists, and some evidence among the historians that they wanted to cultivate productive study habits within their students. Both groups of faculty spoke of or wrote about, in some way, the importance of clearly specifying the expectations for the course. While the chemists stressed completion of homework sets, historians emphasized actively reading the assigned material before coming to class or discussions. Chemistry faculty provided hints on how to tackle problems, as historians gave tips on writing papers. In each of these fields, faculty seemed to believe that developing particular kinds of self-discipline are critical aspects of studying their discipline.

In both fields, also, there was concern about large class sizes. In particular, large classes constrain these scholar-teachers in the types of assignments they can give students because of the burden that reviewing student work poses.

Differences

While the groups shared some general, overarching similarities, they also had their differences. Although each of the groups wanted their students to

learn what it is like to experience the disciplinary perspective they taught from, they appeared to have different perceptions of the population that they were responsible for educating. As I pointed out earlier, the historians appeared to have a strong commitment to the liberal education of all students. The chemists seemed to speak only about teaching scientific skills and knowledge to science majors.

Furthermore, listening to both chemists and historians talk about their students, one comes away with quite different images. From the historians' descriptions of their students and the challenges they face as teachers, one imagines a classroom full of individual people, each with their own unique contributions, perspectives, sets of experiences and goals. The strongly manifested respect for those differences among the students, also revealed an appreciation for and excitement about the uniqueness of each class and what the instructor can learn from the interactions of particular groups of students. Reading the exercises and listening to the conversations of the chemists, I was left with the impression of a monolithic student body which competes among themselves along the same predetermined course. Students' unique, individual needs, goals and interests were not addressed in their discussions or writing.

Implications for Peer Reviewers

While I have presented values which were generally agreed upon by each of the two groups, differences within each of the groups also appeared. For example, I described earlier the differing viewpoints between what I called the "real world problems" chemistry group and the "lecture, homework, test" chemistry group. These two groups seemed to hold different conceptions of students, faculty responsibilities and the skills which are valuable in science Those conceptions affect how those faculty carry out their teaching and what they look for in reviewing a colleague's work.

Similarly, in history, while there was consensus around the importance of having students "do history," actually carrying out the evaluation of teaching based on this idea of "doing history" may turn out to be more difficult. For example, Suzanne Wilson and Samuel Wineburg (Wilson & Wineburg, 1993)present and discuss the dilemma of differing conceptions of history and history teaching which arose while developing assessment standards for high school social studies teachers. In particular, they found that recent developments in social and cultural history led to different generations of teachers drawing on

different notions about what is considered scholarly and legitimate within their field.

These value clashes which may emerge within disciplines and/or within departments may prove to be problematic in the peer review of teaching. Reaching a common set of values on what constitutes "scholarly teaching" and how to evaluate it may mean silencing or shortchanging the most radical teachers as well as reducing the variety of teaching approaches used in a given department or discipline. However, providing occasions in which scholar-teachers can openly examine their values and assumptions about teaching may also lead to strong agreement on particular issues (such as class size limits, for example) on which they can work together in accomplishing their common goals. (Cochran-Smith & Lytle, 1992).

The differences between disciplines described in this paper illustrate that scholars within a particular field are able to have a unique kind of conversation about teaching - about "a pedagogy of substance - rooted in the subject matter itself as well as in a connection with the lives and culture of the [students]," (Shulman, 1989) that cross-disciplinary colleagues could not have. These exchanges allow colleagues to seek assistance on common problems.

At the same time, though, these differences also support calls for cross-disciplinary conversations among teachers on the same campus (such as the peer perspectives projects conducted by Sheila Tobias. (Tobias, 1986; Tobias & Abel, 1990; Tobias & Hake, 1988) Gaining a better appreciation for the values held in different disciplines may help teachers to take a fresh look at the assumptions they hold about university education and how to teach their subject matter to their students.

Better understandings of the core similarities and differences between fields may also be critical for the success of integrated interdisciplinary scholarly endeavors, including the study of education itself, as Margaret Eisenhart and Hilda Borko (Eisenhart & Borko, 1993) found when they began collaborating across disciplinary boundaries (psychology and anthropology). They believe that interdisciplinary studies are more than just analyses which add together questions and findings from two different disciplines, but rather integrate the two in a meaningful way. They discovered that the first step in achieving those shared understandings which make up collaborative interdisciplinary research and teaching programs was to "[clarify] the major themes that each discipline brings to the study" in order to construct a conceptual model which integrates

the two. Thus, gaining better understandings of the core values of one's own and others' disciplines may also facilitate increased communication, smoother collaborations and richer cross-fertilization between scholars with differing disciplinary backgrounds.

Implications for Campus Teaching Improvement or Evaluation Coordinators

Taking a close look at discipline-specific modes of thinking about teaching also has implications for how teaching evaluation coordinators and faculty development professionals work with their clients. First of all, this study calls attention to the potency of the disciplinary contexts within which faculty teach and carry out their scholarly work. Traditionally, faculty development efforts have frequently focused on assisting individual faculty members. (Weimer & Lenze, 1991) Yet, these individual faculty do not exist in a vacuum. They have been socialized within their disciplines and continue to interact most frequently with other members of their discipline because of the confines of departments and disciplinary research communities.[1]

The emerging trend in both the evaluation of teaching and in faculty development is to encourage peer review and departmentally based instructional improvements, though. For administrators or faculty development professionals whose affiliations are outside those departments and disciplines, understanding the currently existing sets of shared assumptions and values within a community is an important first step in their work. Those outside leaders must successfully balance an appreciation for and understanding of the cultural contexts in which they are working, with their goal of changing the practices within that context. A successful balancing act, then, may depend on reformers critically reflecting on their own value stance vis-a-vis those of the groups of scholars they work with, and the perspectives or biases they bring from their own disciplinary backgrounds.

Implications for Future Research

While this study suggests many directions for practice and research, its small scale and exploratory nature requires additional support from further research. To pursue this line of research, scholars of teaching in higher education will find many fruitful parallels in research on primary and secondary school teaching, which has led the way in studying the significance of subject-specific

[1]Primary identification with one's discipline is most common at research and comprehensive universities and less common at small liberal arts colleges and community colleges. (Clark, 1987; Freedman, 1979)

aspects of teaching (Shulman, 1986; Shulman, 1987; Shulman & Quinlan, in press) as well as the significance of the social contexts of teachers' work (McLaughlin & Talbert, 1993). As faculty development and evaluation practices in higher education move toward department and discipline-based interventions, research on teaching in higher education needs to help inform and assess these shifts in practice by gaining better understandings of concepts like the "scholarship of teaching," (Boyer, 1990)and the ways in which teaching and evaluation practices are shaped by the disciplinary and departmental contexts in which they take place.

To accomplish this, researchers will also need to move beyond the "process-product" tradition of research on teaching (which simply seeks correlations between teacher behaviors and student behaviors and responses) to embrace alternative paradigms and methods which permit study of the rich cognitive and social contexts in which teaching and decisions about teaching take place (Shulman, 1986(1990)).

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